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Title page

Interventions to improve the management of pain in Emergency Departments: systematic review and narrative synthesis.

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Abstract

Introduction

Pain management in Emergency Departments (EDs) is often inadequate despite the availability of effective analgesia, with many patients receiving insufficient and untimely analgesia. We conducted a systematic literature review to identify interventions that could improve pain management in the ED.

Methods

We systematically searched seven databases for studies reporting pain management outcomes after intervention to change professional practice to improve pain management in the ED, compared to pain management before or without intervention. Data was synthesized using principles of narrative synthesis.

Results

We identified 43 relevant studies, including 40 uncontrolled before-and-after studies. Interventions included implementation of guidelines and protocols, educational interventions, pain scoring tools and changes in nursing roles, with many multi-faceted interventions incorporating two or more of these elements. Interventions aimed to improve assessment and documentation of pain, knowledge and awareness of pain management and reduce time to analgesia. Due to the high probability of bias in study design and significant variation between studies, it was not possible to estimate the overall effectiveness of interventions, or identify which had the greatest impact. Intervention to improve pain management was reported to have some positive impact in most studies, but these findings may be explained by limitations in study design.

Conclusions

Many interventions reported improvements in pain management but current evidence is insufficient to recommend any for widespread adoption. In order to improve pain management we need to understand more about the theory underlying interventions, the context in which interventions work and develop interventions based on this stronger theoretical understanding.

Introduction

The inadequate treatment of pain within emergency departments (EDs) is a well documented problem worldwide[1,2]. Suggested reasons for the under-treatment and untimely treatment of pain include lack of awareness of pain management, difficulties in assessing and re-assessing pain and structural problems within the ED contributing to delays[2,3]. Various effective pharmacological and non-pharmacological treatments to reduce pain are available within EDs but despite the existence of comprehensive guidelines to assist the management of pain within EDs[4,5,6] under- and inappropriate prescribing of analgesia and delays to analgesia for patients with painful conditions remains a significant problem. Interventions to change professional behaviour within the ED may help to improve the management of pain within the ED.

A number of interventions to change professional behaviour have been evaluated in other settings. Change in practice is more likely to be effected by use of active methods and by multifaceted strategies that incorporate a range of methods to change practice[7,8,9]. Similarly, interventions are more likely to work if they have some 'ownership' or organisational support, and are feasible in practice[8,10] . Interventions to improve the use of analgesia and processes for providing analgesia within EDs potentially include the introduction of protocols and guidelines, incorporating and mandating pain scoring tools within the triage process and the use of educational interventions to improve awareness and knowledge of pain management within the ED. We are not aware of any attempt to systematically evaluate the various potential methods and draw conclusions about which should be recommended for general adoption.

This systematic review of the literature aims to identify interventions that could improve the management of pain in the ED and synthesize the existing literature to identify which interventions work. Specifically, the review sought to identify any intervention seeking to improve the delivery of pain management and change pain management behaviour within an ED, rather than identify optimal treatments or test the efficacy of individual treatment modalities.

Methods

Search strategy

We searched the following databases in December 2012: Medline (via Ovid), Embase (via Ovid), Cinahl (EBSCO), Web of Science, Cochrane central register of controlled trials. We also searched Opengrey (previously SIGLE) and Health Management Information Consortium for grey literature. No limits were placed on year of publication or language. We also searched reference lists of general reviews of pain management in EDs and reference lists of all included studies. Hand-searching of journals was not undertaken as the pain management interventions used in EDs were reported in a wide range of journals and the search criteria were felt to be broad enough to incorporate any relevant articles. (See appendix 1 for search terms used). Prospero registration number Prospero 2013:CRD42013002542.

Study selection and inclusion criteria

Studies were selected using PICOS criteria (population, interventions, comparator, outcomes, study design). The population included patients presenting to the ED with any condition and of any age. The intervention must have aimed to alter the management of pain for any population of patients attending the ED by changing clinical behaviour around the management of pain. The intervention must have sought to act at an organisational level rather than patient level and needed to include all patients prior to pain assessment being undertaken. Studies reporting efficacy of a drug or method of delivery of analgesia alone were excluded. Studies must have included some form of comparison group who have not received the intervention. Studies reporting the following changes in outcomes related to pain management were included: proportion of patients receiving analgesia, time to analgesia, change in pain score, proportion of patients receiving adequate analgesia, documentation of pain score, reassessment of pain, repeat dosing of analgesia, patient satisfaction. Any study design was included, provided there was some form of comparison group.

As a broad search strategy was used to maximise sensitivity, screening was performed on a two stage basis; initial screening to identify articles relating to any interventions targeting pain management in the ED were identified by one reviewer (FS) and these were then reviewed by two reviewers (FS and SG) to identify which articles met the above criteria. Any discrepancies were resolved by discussion.

Data extraction and assessment of risk of bias

Data extraction and validity assessment was undertaken by a single reviewer. Double extraction was planned in the event of quantitative synthesis being undertaken, but was not required.

Assessment of the risk of bias within studies was undertaken using study-specific quality assessment criteria designed to address a range of potential sources of bias. This was felt to be more appropriate to the review than existing checklists[11,12] and was adapted from criteria used in previous reviews that included non-randomised study designs[13,14].

Data synthesis

We planned to undertake meta-analysis if appropriate data existed but were ultimately unable to due to the high level of potential bias within the included studies and the level of heterogeneity between studies. Data was synthesized using narrative synthesis, which describes the scope of existing

research and summarises data using structured narratives and summary tables. Narrative synthesis was undertaken following the four principles proposed by Popay et al[15]: (development of theory of how the intervention works, why and for whom; development of a preliminary synthesis of findings of included studies; exploration of relationships in the data and assessment of the robustness of the synthesis). Additionally, the introduction and discussion sections of included articles were reviewed to elicit the aims of the intervention and any lessons around feasibility and acceptability of interventions in the ED.

Studies were categorised according to typology of interventions, developed from theories around the aim of the intervention. Results were also briefly summarised by outcome, although due to the high risk of bias within results, the results focussed upon the types of interventions reported.

Results

A total of 8046 articles were identified and titles and abstracts reviewed. 75 articles were then identified for review by both reviewers and 71 articles included. A further 4 were excluded at the data extraction process as they were subsequently found not to meet the inclusion criteria. A total of 42 studies were included in this review. The kappa score for inter-rater agreement on articles to include was 0.81.

Characteristics of included studies

There was significant variation between studies in terms of important variables including design of the intervention, outcomes reported, length of follow-up, patient group and country (see table 1).

Table 1: Characteristics of included studies

Author	Year	Country	Population	Age	N	Study design
Baumann[16]	2007	USA	Traumatic or non-traumatic pain	>8	768 v 474	B / A
Blankenship[17]	2012	USA	Any pain-related complaint	18+	646 v 592	B / A
Boyd[18]	2005	Australia	Peripheral limb injuries	Paediatrics	151 v 140 v 126	B / A
Campbell[19]	2004	USA	Any non-urgent pain	NR	N/A	B / A
Clere[20]	2001	France	All patients	NR	1839 v 1984	B / A
Corwin[21]	2012	USA	All patients in pain	Paediatrics	103 v 109	B / A
Crocker[22]	2012	USA	Painful condition, injury or procedure	Paediatrics	531 v 263	B / A
Day[23]	1995	USA	Acute low back pain	>16	103 v 259	B / A
Decosterd[24]	2007	Switzerland	Any acute or recent pain	Adult	249 v 192	B / A
Doherty[25]	2012	Australia	Abdominal and pelvic pain, injuries.	All	16,627 total	Stepped wedge design
Eisen[26]	2007	UK	Any painful conditions	Age 4-16	115 v 116	B / A
Ender[27]	2010	USA	Sickle cell disease with vaso-occlusive pain	Age 3-18	68	Cohort
Fosnocht[28]	2007	USA	Traumatic extremity or back pain	18+	471 v 112	B / A
Gawthorne[29]	2010	Australia	Trauma patients	NR	100 v 100	B / A
Goodacre[30]	1996	UK	Acute skeletal injuries	NR	200 v 200	B / A
Hawkes[31]	2008	Ireland	NR	Age 1-16	95 v 145	B / A
Iyer[32]	2011	USA	Isolated long-bone extremity fracture	Paediatrics	387 v 615	B / A
Jackson[33]	2010	USA	Hip fracture	>65	151 v 151	B / A
Jadav[34]	2009	UK	Long bone fracture, burns	<=11	187 v 163	B / A
Jones[35]	1999	USA	Acute painful conditions	NR	54 v 72	B / A

Author	Year	Country	Population	Age	N	Study design
Kaplan[36]	2008	USA	All patients	Age 3-20	462 v 372	B / A
Kelly[37]	2000	Australia	Long bone fractures	NR	79 v 83	B / A
Kelly[38]	2000	Australia	Renal colic	NR	63 v 65	B / A
Kuan[39]	2010	Ireland	Any pain complaint	NR	50 v 50 v 51	B / A
LeMay[40]	2009	Canada	Burn, fracture, laceration, sprain or acute abdominal pain	Paediatrics	150 v 104 v 119	B / A
Morrissey[41]	2009	USA	SCD with pain	Paediatrics	51 v 212	B / A
Muntlin[42]	2011	Sweden	Abdominal pain	18+	50 v 100 v 50	B / A / B
Nelson[43]	2004	USA	Renal colic, extremity trauma, headache, opthalmologic trauma, soft tissue injury	NR	521/479	B / A
Odesina[44]	2011	USA	Sickle Cell Disease	Adults	44 v 66	B/A
Perron[45]	2007	Switzerland	All patients	Age 18+	653 v 337 v 419	B / A
Rogovik[46]	2007	Canada	Limb or clavicle injury	Paediatric 3+	179 v 131	B / A / B / A
Santervas[47]	2010	Spain	Abdominal pain, chest pain, headache	Age 3-18	150 v 150	B / A
Somers[48]	2001	UK	Painful injuries	<16	129 v 133	B / A
Stalnikowicz[49]	2005	Israel	Orthopaedic conditions	12+	70 v 70	B / A
Steinberg[50]	2011	USA	Renal colic (diagnosed)	Age 18-65	50 v 44	B / A
Sucov[51]	2005	USA	Long bone or extremity fractures	All	235 v 1219	B / A
Tanabe[52]	2012	USA	Sickle Cell Disease with vaso-occlusive pain	Adults	959 v 807 v 1169	Cohort
Thomas[53]	2004	USA	All patients	18+	100 v 100 v 100	RCT
Vazirani[54]	2012	Australia	All patients	Adults	8743 v 8462 v 9043 v 9380	B / A
Williams[55]	2012	Australia	Abdominal pain	Age 2-16	80 v 80	B / A
Wong[56]	2007	Hong Kong	Minor isolated single limb injury	18+	96 v 199	B / A
Yanuka[57]	2008	Israel	Minor-moderate trauma	18+	1000 v 700	B / A

Studies were predominantly before and after studies in a single site (n=38), with different lengths of follow-up period. There were two cohort studies of patients with sickle cell disease attending ED for vaso-occlusive crisis pain and one randomised controlled trial of different methods of displaying pain scores within ED charts. One study reported a stepped-wedge design of 55 Australian EDs involved in a national pain initiative project.

Study populations consisted of all patients attending the ED (n=5), patients with a range of painful conditions (n=17) and specific conditions (n=19), including fracture (n=5), renal colic (n=2), sickle cell disease (n=4) and others (n=8). One study did not specify their inclusion criteria.

Results from the assessment of risk of bias are shown in table 2. The level of risk of bias was high, notably due to the uncontrolled before and after design as well as lack of blinding, unmatched data collection periods and differences in collection of pre- and post- intervention data.

Table 2: Assessment of risk of bias

Author	Comparability [1]	Period of assessment [2]	Representative [3]	Blinding [4]	Contamination [5]	Reporting bias [6]	Prospective [7]
Baumann	N	N	NR	Y	NR	Y	P/P
Blankenship	Y	N	N	Y	NR	Y	P/P
Boyd	NR	N	Y	NR	NR	Y	P/P
Campbell	NR	N	N	NR	NR	NR	NR
Clere	NR	N	NR	NR	NR	Y	R/P
Corwin	Y	N	N	N	NR	Y	P/P
Crocker	N	N	Y	NR	NR	Y	P/P
Day	NR	N	Y	NR	NR	Y	R/R
Decosterd	Y	N	Y	N	N	Y	P/P
Doherty	Y	Y	Y	NR	NR	Y	R/R
Eisen,	NR	N	NR	NR	NR	NR	NR
Ender	NR		NR	NR	NR	NR	P (cohort)
Fosnocht	NR	N	N	Y	NR	Y	R/P
Gawthorne	Y	N	Y	N	NR	NR	R/R
Goodacre,	NR	N	Y	N	NR	NR	P/P
Hawkes	NR	N	Y	NR	NR	NR	R/R
Iyer	NR	N	NR	NR	Y	Y	R/R
Jackson	NR	N	Y	NR	NR	NR	R/P
Jadav	NR	N	NR	N	NR	NR	R/R
Jones	Y	N	N	Y	NR	Y	P/P
Kaplan	N	N	NR	Y	NR	Y	R/R
Kelly	Y	N	Y	NR	Y	NR	R/R
Kelly	Y	N	Y	NR	NR	NR	R/R
Kuan	NR	N	NR	NR	NR	NR	NR
LeMay	NR	N	Y	NR	NR	Y	R/R
Morrissey	Y	N	Y	NR	NR	NR	R/R
Muntlin	Y	N	Y	N	NR	Y	P/P
Nelson	Y	N	Y	Y	NR	Y	R/R
Odesina	NR	N	NR	NR	NR	NR	R/P
Perron	NR	N	Y	NR	NR	NR	R/R
Rogovik	NR	N	Y	N	NR	Y	P/Unclear
Santervas	NR	N	Y	NR	NR	NR	R/R
Somers	Y	N	NR	NR	NR	Y	R/R
Stalnikowicz	Y	N	Y	NR	NR	Y	P/P
Steinberg	Y	N	NR	N	NR	Y	R/P
Sucov	NR	N	Y	NR	Y	NR	R/R
Tanabe	Y		Y	NR	NR	Y	P (Cohort)
Thomas	Y	Y	Y	Y	NR	Y	P (RCT)
Vazirani	Y	N	Y	Y	Y	Y	NR
Williams	Y	N	NR	NR	NR	Y	R/R
Wong	Y	N	N	N	Y	NR	P/P
Yanuka	Y	N	N	NR	NR	NR	P/P

Y=Yes, N=No, NR= Not reported, P=Prospective, R=Retrospective

1. Were groups comparable in terms of baseline characteristics thought to affect pain management?
2. Were control and intervention groups concurrent?
3. Were subjects representative of the study population (random or consecutive recruitment)
4. Was there any evidence of blinding staff or patients?
5. Did authors discuss any concurrent interventions that may contaminate results?
6. Were all main outcomes reported?

7. Was data collected in similar methods for control and intervention? Report whether prospective/retrospective for each.

Data synthesis.

Stage 1: Development of theory of how the intervention works, why and for whom

There are many different theories about why pain management is poor in the ED but little empirical evidence supporting any individual theory. As a consequence, the type of intervention used to improve pain management depends upon the prevailing theory of why pain management is poor. Very few studies explicitly reported the rationale or theory behind the development of an intervention. Because of this, we identified the distinct rationales and types of intervention based on reading the articles. This was used as a preliminary theoretical framework for synthesizing results. (See table 3)

Table 3: Theoretical framework developed by the research team.

How the intervention works	
1. Changing subjective measurement of pain into an objective measure by using **pain scoring tools**	Pain is a subjective measure that is difficult to assess and there are differences in the estimation of pain by clinicians, nurses and patients [58]. In order to be treated properly, pain needs to be assessed by an objective, validated pain scoring tool that can be understood by patients, clinical and nursing staff. The use of pain scoring tools should therefore improve ED staff awareness of patients' pain and allow them to administer analgesia accordingly.
2. Removing **structural barriers** that lead to delays in provision of analgesia	Barriers to timely analgesia include physical access barriers and delays associated with the need for medical staff to assess and prescribe opioids and other narcotics. Structural changes to the ED as well as changes to the nursing role (e.g. nurse-initiated analgesia) should improve pain management, as nursing staff have a lower turnover, a greater belief and desire for change in practice and are more able to estimate patient's pain than medical staff [42,45].
3. Removing **attitudinal and knowledge barriers** to the management of pain	ED staff receive very little training about the importance of pain management and a lack of knowledge and misbeliefs around pain management are seen as barriers to the delivery of appropriate analgesia. Educational interventions should therefore help to increase ED staff understanding of the theory behind pain management and enable them to improve the management of pain. Similarly, pain protocols should decrease staff uncertainty and provide information as to how to manage pain and offer appropriate analgesia.
4. Combining different methods of improving behaviour change to address different aspects of poor pain management	The reasons for poor pain management are multiple and complex, and therefore need addressing with a multifaceted intervention which involves a combination of methods (e.g. protocol with education and pain scoring) to maximise behaviour change around pain management. Problems may be department specific and can best be resolved by individualised interventions taking into account the needs of the department. A combination of these methods may lead to increased effectiveness, as seen in other contexts [8]
5. Understanding how pain can be managed better within an individual department by developing interventions based upon diagnostic analysis of the	Research in other settings suggests that interventions attempting to change behaviour should involve a 'diagnostic analysis' to identify barriers and factors likely to affect change [10]. Studies that have undertaken research or audit in their departments and developed interventions based on a strong theoretical framework are more likely to address barriers to pain management and therefore achieve an improvement in pain management within their ED.

problems within that department.	

Results of included studies could also be categorised according to outcome, country of origin or population studied as there is a clear rationale for not combining results for each of these characteristics. However, as the focus was not on effectiveness due to the design of studies included, the categorisation by 'type' of intervention was undertaken to allow lessons about feasibility and acceptability to be included.

Stage 2: Development of a preliminary synthesis of findings of included studies.

Full details of the interventions and study findings are included in appendix 2. The types of intervention, outcomes reported and any significant results are summarised in table 4 and discussed in stage 3 below.

Table 4: Components of interventions and outcomes reported

	Components of interventions										Outcomes reported							
Author	Pain protocol /	Documentation	Educational	Nurse admin	Other	Training in use	Audit and	Reminders	Theoretical	Local	AA	AAA	TTA	DPS	RDPS	RedPS	RAA	PatSat
Baumann		•									•			• *	• *			
Jadav		•									•	• *		• *				
Kaplan		•				•					•		• ^	• *				
Nelson		•									• *		• ^					
Rogovik		•									• ^	•	•					
Thomas		•									• *	• ^	• *			•		
Blankensh ip					•	•					•		•					
Day					•	•				•	•	•						
Clere	•											•						
Eisen,	•	•									• *		• *	• *				
Ender, K	•					•						• *	• *					
Goodacre,	•						•				• ^	• ^						
Morrissey	•				•					•		• *	• *	• *				
Steinberg	•									•		• *	•					
Tanabe	•			•	•		•			•			• -			• *		• ^
Jackson			•								• ^		•		• *			
Jones			•							•						• *		
LeMay			•							•	• *			• *				
Sucov			•				•				• *							
Boyd		•		•		•	•				• *		• *					
Campbell	•		•		•		•											
Decosterd	•		•					•			• ^		•		• ^	•		• ^
Fosnocht	•	•		•		•	•				• ^		• *			• ^		
Gawthorn e	•		•					•		•	• *	• *	• ^	•				
Kuan	•		•								•		• ^	• *	• -			
Muntlin	•		•	•						•	• *		• *					•
Odesina	•		•									• ^	• ^					
Santervas	•	•				•					• ^			• *				
Somers	•		•		•			•					• *					
Vazirani		•	•								• ^		• ^	• ^				

	Components of interventions										Outcomes reported							
Author	Pain protocol /	Documentation	Educational	Nurse admin	Other	Training in use	Audit and	Reminders	Theoretical	Local	AA	AAA	TTA	DPS	RDPS	RedPS	RAA	PatSat
Wong	•	•	•	•						•			•	• *		•		
Yanuka	•		•		•		•			•	• *		• *		•			• *
Corwin	•	•	•					•	•	•			•		• *	•		
Hawkes	•	•		•		•	•	•	•	•	• ^		• ^	• ^				
Iyer	•								•	•			• ^					• ^
Kelly	•	•		•					•	•	•	• *						
Kelly	•								•	•		• *						
Perron	•	•	•		•		•		•	•	• *			• *	• *			•
Crocker	•	•	•						•	•								•
Doherty	•		•		• [1]		•		•	•		• ^	• *	• *				
Williams	•	•						•	•	•			•	• *	•			
Stalnikowicz,	•								•	•	• ^		• *					

[1] Interventions differed by site but included some of these components. They were all individually tailored and encouraged to use the components listed.

Outcomes:
AA –proportion of patients administered analgesia
AAA – proportion of patients administered appropriate analgesia
TTA – time to analgesia
DPS – documentation of pain score
RDPS – repeat documentation of pain score
RedPS – reduction in pain score between admission and discharge from ED
RAA – repeat analgesia administered
Patsat – patient satisfaction outcomes reported

• ^ outcome reported but significance not measured
• * significant improvement in outcome found ($p<0.05$)
• - significant deterioration in outcome found ($p<005$)
• no significant improvement in outcome found

The most commonly reported outcomes were proportion of patients given analgesia (n=26) and time to analgesia (n=27). For both measures, ten reported a significant improvement and the remainder reported no significant difference (n=7, n=8 respectively) or did not report significance levels (n=9, n=8). One study reported a significant increase in time to analgesia. There were 14 studies that reported the proportion of patients who were given appropriate or adequate analgesia as an outcome (though the definition of 'appropriate' differed between studies), 7 of which reported a significant improvement. Fifteen studies reported documentation of pain score as an outcome, of which 11 reported a significant improvement. Only seven studies reported reduction of pain score as an outcome, of which two saw a significant reduction in score.

The different elements of interventions are discussed in table 5 below. Studies attempted to improve implementation of the intervention by offering training in the use of the intervention (n=8), audit and feedback (n=10) and making use of reminders (n=6). Nearly half of the interventions (n=20) were developed in-house, using local staff and knowledge.

Stage 3: Exploration of relationships in the data

Key messages emerging from analysis of the studies are summarised in table 5. There was some overlap within the 'types' of intervention and some studies were included within more than one category.

Table 5: Key messages from studies grouped by rationale for intervention.

Method	No. studies	Key messages
1. Interventions aiming to encourage objective measurement of pain by using **pain scoring tools**	Six studies reported on the use of a pain scoring tool alone, either as an addition to the existing triage tools or as a mandated part of the triage process. A further twelve used pain scoring within a multifaceted intervention. One RCT reported 3 different methods of displaying pain scores.	Studies concluded that improving the use and availability of pain scoring tools increased the documentation of pain, but that this did not translate into an increase in the proportion of patients receiving analgesia (with the exception of one study[43]). Little discussion as to why the use of a pain score had not translated into improved analgesia. The use of pain scoring tools was common in multifaceted interventions and appeared to be an inexpensive, simple and acceptable method of improving pain management. The single RCT identified within this review compared different ways of presenting the VAS and reported higher physician awareness of pain scores where VAS was measured every 12 minutes and reported on a graph at the end of the bed, compared with a 2 measurements of VAS at presentation and 2 hours. This was associated with expedited analgesia (p,0.00001) but there was no significant difference in the % given analgesia (p=0.69) [53]
2. Interventions aiming to remove **structural barriers** that lead to delays in the provision of analgesia	Seven studies reported interventions that included introduction of nurse-initiated analgesia as a method of reducing delays to analgesia but these were all part of multi-faceted interventions. No interventions aimed to remove structural barriers alone.	Organisational changes reported as part of a multi-faceted intervention included nurse-initiated analgesia as an alternative to clinician administered analgesia (n=7), changes to physical access to opioids (n=1) and changes to the process of physician prescribing to decrease the length of time required to obtain analgesia (n=1). Changes to the role of nursing staff were felt to have a positive impact upon the pain management process. Interventions aimed at involving nurses more in the assessment and treatment of pain suggested that nurses can make autonomous decisions regarding the prescription of analgesia and the use of nurse-initiated analgesia was safe and well accepted by nurses[42]. There was some evidence that interventions aimed at nurses had improved uptake than those aimed at doctors [43, 46]. The high turnover of medical staff has been identified as a barrier to the uptake of interventions[45] and therefore the lower turnover of nursing staff should enable effectiveness of interventions to be sustained.
3. Interventions aiming to remove attitudinal and knowledge barriers to pain management	In total, 33 studies reported on interventions incorporating pain protocols or education to improve knowledge around pain management. Eighteen studies reported on the use of an educational intervention either alone (n=3) or within a multi-faceted intervention (n=15) and 28 studies reported on interventions including protocols or guidelines, either alone (n=6) or as part of multifaceted interventions (n=22).	Studies of educational interventions reported varying levels of success in improving pain documentation and administration of analgesia. Interventions differed in content, format, length and coverage. Success was attributed to the active nature of an educational intervention[40], simplicity[51] and ability to fit round work schedules[40]. Ongoing education and reminders are needed due to rapid turnaround of medical staff. Protocols ranged from simple guidelines offering specific treatment and dosing guidance for a well-defined group of patients[50], to more complex protocols providing specific information as to how pain should be managed within the departments, and may include reinforcement of existing procedures or a change in pain management procedure, or reinforcement of existing procedures (e.g. [21]). Some included department-specific information as to how the patient should be assessed, by whom and specific recommendations for reassessment of pain. Considerable variation in the level of detail of the contents of protocols reported within studies, making comparison of their content difficult. Authors offered little insight into the feasibility or acceptability of protocols, despite largely concluding that the introduction of a protocol

		led to improved outcomes in their populations. Two studies reported variable or poor compliance with the protocol but did not discuss potential reasons [31, 28]. The use of pain scoring tools within protocols was felt to help appropriate pain management as recommended analgesia route and dosage was often related to pain severity
4. Multifaceted interventions aiming to combine different methods of improving behaviour change to address different aspects of poor pain management	The majority (n=26) of studies reported on multifaceted interventions that included more than one of the individual 'types' of interventions.	Interventions most commonly combined a protocol with use of pain scoring tool (n=10) or protocol and educational intervention (n=13). Interventions were also considered multifaceted if they made use of additional tools to improve implementation that have been shown to work in other settings (e.g. audit, feedback, reminders). Only a subset of these interventions referred to themselves as 'multifaceted interventions'. Interventions reported on a range of outcomes and authors concluded that it was difficult to differentiate which parts of the multifaceted intervention had contributed to any success. There was little discussion of the benefits of multifaceted interventions, although one study undertaking pre-intervention audit concluded that a range of drivers were essential as optimising one driver at a time did not achieve the magnitude of effect required[32].
5. Interventions based upon diagnostic analysis of department specific problems in order to understand how pain can be managed better within that department.	Seven studies reported multifaceted interventions with an explicit theoretical framework that had been developed following research or audit into the barriers existing within their department.	Studies provided little detail on how the research or audit that identified the barriers around which interventions were developed. Studies did not comment on how the targeting of interventions to department-specific problems may have impacted upon the uptake or success of the intervention. Doherty et al [25] developed a national project to compare pain management based upon findings of an extensive barrier analysis [61] and reported results of a large study with step-wedged design. Local protocols were developed at each site, addressing 4 main clinical indicators aimed at monitoring key components of analgesic practice. There was no significant decrease in pain levels, although an increase in documentation of pain scores and reduction in time to analgesia was observed. As there was no single protocol, it was not possible to attribute any improvements in outcome to any specific part of the intervention.

Further exploration of outcomes

There did not appear to be any particular type of intervention that may correlate with either improved rates of analgesia or reduction in time to analgesia. Of the seven studies reporting significant improvement in rates of appropriate or adequate analgesia, six included the use of a protocol or guideline. This result, though interpreted cautiously, is encouraging as many of the protocols included information about the correct route and dosage of analgesia in order to ensure the analgesia is administered appropriately.

Ten of the eleven studies that reported a significant improvement in documentation of pain included pain scoring within their intervention, either alone or within a multi-faceted intervention, suggesting that the inclusion of pain scoring may improve documentation. The number of studies reporting reduction in pain score was low, which may be due to the difficulty in recording this as an outcome as full recording of pain score at the beginning and end of the ED visit is required.

Stage 4: Assessment of the robustness of the synthesis

Any attempt to synthesize data across different groups must be interpreted cautiously. There are a number of different factors within studies of pain management in EDs that influence the effectiveness of any interventions attempted. The populations studied varied widely both in terms of ages and conditions included. Assessing the success of interventions is more difficult in paediatric populations due to communication of pain levels. Pain relief is harder to achieve in certain conditions[21] and pain is more likely to be treated when known to be due to a painful condition (e.g. fracture)[17, 42] and less likely when diagnostic workup is required[43].

Differences in settings, particularly country, will influence effectiveness of interventions due to different expectations of pain relief and baseline levels of pain management. The implementation of pain protocols may have less impact in countries such as the USA and Australia where there are already strong national guidelines and national bodies already recommend the mandating of pain scoring [4, 59]

Differences in length and timing of follow-up can affect outcomes, and is a source of significant bias in before and after studies. Several studies reported follow-up at less than one month post-intervention, when the 'honeymoon' effect would likely still be strong. Outcomes from studies with significantly longer follow-up risk contamination due to secular trends[60]. The time periods used to assess pre- and post-intervention outcomes were often not comparable in terms of length of time and seasonality, despite ED attendances being highly seasonal[61] and correlation between quality indicators and 'busyness' of a department[62]. There was considerable variation within the 'types' of interventions reported and there is little value to comparing, e.g. a department-specific protocol reinforced by interactive educational sessions, audit and reminders with a more simple protocol reinforced by a single didactic education session.

Discussion

Despite a very broad search and wide inclusion strategy this evidence synthesis revealed a lack of good quality evidence of effectiveness of interventions to improve pain management within emergency departments. Over 70 studies were identified and 42 included, yet all but four used an uncontrolled before and after study design, with just one RCT looking at methods of displaying pain scores. This RCT compared methods of presenting pain scores with a 'control' of the VAS recorded at presentation and at 2 hours, which will not represent current practice in many EDs and therefore limits the utility of the study's conclusions[53]. We aimed to identify generalizable methods to improve the provision of analgesia within the ED, which requires studies that compare interventions to control groups, preferably using multicentre evaluation. However, a lack of such studies precluded any meta-analysis of results to identify any single method that is most effective at improving pain management. Also, there was significant variation in the design of interventions, populations studied, length of follow-up and outcome measures used. However, the use of narrative synthesis allows a comprehensive synthesis of the literature pertaining to pain management interventions within the emergency department and offers some lessons about the feasibility of implementing interventions that may be useful in improving local practice.

The primary aim of this systematic review was to identify any interventions that could be adopted to improve pain management within the ED as part of evidence based practice. The review did not identify any particular intervention that could be recommended for implementation, due to a paucity in quality of evidence. It may also be the case that even with good quality evidence there is no 'magic bullet' that can be recommended as a 'solution' for all. Due to the large degree of variation within multifaceted interventions, it was difficult to attribute any level of 'success' to an individual element of the intervention[25, 55]. As in other areas, the value of the intervention will depend upon the context and an individual intervention may only work within the setting for which it was designed [10]. The level of 'success' of an intervention will depend upon the baseline performance of a department, and the degree to which the intervention has been tailored towards a specific department's needs[25].

Many of the studies included within this review were based upon local audits undertaken by nursing and clinical staff with little or no external support or funding. Studies often reported their intervention to be successful in terms of pain management even where most of their pre-specified outcomes had not shown significant change. It may be that the implementation of an intervention did have positive effects for that department, although there are too many potential sources of bias for the results to have any external validity. The process of developing an intervention, and in particular feeding back the results of pre-intervention audits, may have been sufficient to raise the profile of pain management within EDs, regardless of the type of intervention used. The use of audit as an intervention in itself has been shown to have a moderate impact upon changing clinical behaviour in other settings[8]. Some studies within this review reported that a change in practice had been observed following feedback of the pre-intervention audit, and prior to an intervention being implemented, as some EDs needed the audit feedback to understand how they were performing[55, 63].

Implications for future research

Future research into interventions for pain management should consider carefully which outcomes to report. Whilst studies may report a change in processes used, this does not always translate into patient-oriented outcomes such as reduction in pain score, or reduction in time to analgesia. Patient-centred outcomes such as reduction in pain score or patient satisfaction should be used within future evaluation of interventions to improve pain management.

Although future studies of interventions to improve pain management in EDs would benefit from a stronger research design (e.g. cluster RCT), it is unlikely that the evaluation of any individual intervention will provide valid recommendations for adoption that could be generalised to other EDs without a stronger theoretical underpinning for the interventions. It is probable that a 'magic bullet' intervention does not exist, and future research needs to focus on factors associated with improved pain management in order for EDs to develop interventions specific to their needs. A stronger theoretical framework for interventions, combined with more robust evaluation designs such as RCTs, will enable EDs to understand how and why an intervention works, and under what conditions it may succeed.

Conclusions

There is currently insufficient evidence to recommend any interventions to improve pain management within EDs for widespread adoption, and it is likely that interventions need to be tailored to individual settings in order to address barriers that exist within that department. Interventions to improve pain management should be formed upon a stronger theoretical understanding of how and why interventions may work. They should be developed following diagnostic analysis of an individual departments' needs, include adequate pain assessment and reassessment and attempt to identify and address structural and attitudinal barriers to pain management. Evaluations of interventions should ensure that patient-oriented outcomes are reported and use robust evaluative designs.

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